HERMLE
LABORTECHNIK

Service Manual
for
High Speed Centrifuge
Z 32 HK

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6. Technical Data

6.1 Acceleration times Z 32 HK (120 V / 230 V) in min/sec

Rotor-Number	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Level 9
220.72 V06	1:45	0:52	0:36	0:28	0:23	0:19	0:17	0:15	0:14	0:14
220.78 V06	8:15	4:10	2:43	2:04	1:40	1:23	1:13	1:07	1:02	1:01
220.87 V10	4:19	2:10	1:27	1:06	0:53	0:45	0:40	0:36	0:33	0:31
220.88 V07	3:22	1:40	1:08	0:51	0:41	0:35	0:30	0:27	0:25	0:22
220.89 V09	1:29	0:46	0:31	0:24	0:20	0:17	0:15	0:14	0:13	0:12
220.92 V06	3:20	1:40	1:08	0:51	0:41	0:35	0:30	0:27	0:24	0:22
221.54 V02	2:00	1:06	0:40	0:31	0:25	0:21	0:18	0:16	0:14	0:13
221.55 V02	1:58	0:58	0:40	0:31	0:25	0:21	0:18	0:16	0:14	0:13
221.12 V03	1:33	0:48	0:33	0:25	0:21	0:18	0:16	0:14	0:13	0:12
221.16 V03	2:38	1:21	0:52	0:40	0:33	0:28	0:24	0:21	0:20	0:18
221.17 V03	4:11	2:06	1:24	1:04	0:52	0:44	0:39	0:35	0:33	0:31
221.18 V02	8:35	4:09	2:45	2:03	1:41	1:25	1:14	1:07	1:05	1:02
221.19 V02	1:55	1:01	0:40	0:31	0:25	0:22	0:19	0:17	0:16	0:15
221.20 V02	8:31	4:20	2:51	2:08	1:45	1:28	1:16	1:09	1:04	0:58
221.22 V02	6:52	3:28	2:17	1:44	1:24	1:11	1:01	0:58	0:51	0:50
221.28 V02	7:06	3:28	2:23	1:44	1:24	1:11	1:01	0:54	0:49	0:46
221.38 V02	1:44	0:53	0:36	0:28	0:23	0:19	0:17	0:15	0:14	0:13

Table 1: Acceleration times

The acceleration and deceleration times may have slight fluctuations that depend on the unit and are therefore guidelines only.

6.2 Decelertaion times Z 32 HK (120 V / 230 V) in min/ sec

Rotor-Number	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Level 9
220.72 V06	6:14	0:53	0:37	0:29	0:24	0:20	0:18	0:16	0:15	0:13
220.78 V06	23:27	3:52	3:32	1:55	1:33	1:17	1:06	0:58	0:52	0:46
220.87 V10	8:10	2:08	1:25	1:04	0:52	0:44	0:37	0:34	0:31	0:28
220.88 V07	5:13	1:39	1:07	0:51	0:41	0:35	0:30	0:27	0:25	0:22
220.89 V09	3:36	0:44	0:24	0:23	0:19	0:16	0:14	0:12	0:12	0:11
220.92 V06	5:07	1:40	1:08	0:52	0:42	0:36	0:32	0:28	0:25	0:23
221.54 V02	6:28	1:03	0:43	0:34	0:27	0:24	0:21	0:19	0:17	0:17
221.55 V02	7:42	1:03	0:44	0:34	0:28	0:24	0:22	0:20	0:17	0:17
221.12 V03	5:28	0:41	0:29	0:24	0:19	0:17	0:14	0:13	0:12	0:11
221.16 V03	10:44	1:19	0:52	0:40	0:33	0:28	0:24	0:21	0:20	0:18
221.17 V03	10:24	2:25	1:36	1:13	0:59	0:50	0:43	0:38	0:35	0:32
221.18 V02	31:09	4:08	2:43	2:02	1:40	1:23	1:11	1:02	0:56	0:51
221.19 V02	12:57	1:00	0:40	0:31	0:25	0:22	0:19	0:17	0:16	0:15
221.20 V02	24:20	4:18	2:48	2:07	1:42	1:25	1:14	1:04	0:57	0:51
221.22 V02	18:07	2:42	1:50	1:22	1:07	0:56	0:50	0:44	0:39	0:37
221.28 V02	19:46	3:01	1:58	1:29	1:12	1:00	0:52	0:46	0:41	0:36
221.38 V02	3:32	0:43	0:30	0:23	0:18	0:15	0:13	0:11	0:10	0:09

Table 2: Deceleration times

The acceleration and deceleration times may have slight fluctuations that depend on the unit and are therefore guidelines only.

6.3 Imbalance shut off data Z 32 HK (120V / 230 V)

All rotors are set by the work of using motion detectors, but they can also be set by the imbalance switch (See chapter 7.2.10 and 7.4.13.):

Rotor-number	Shut off speed in rpm	Permitted imbalance in gram	Imbalance shut off in gram
220.72 V06	1000	10	12
220.78 V06	9000	5	6
220.87 V10	7500	3	5
220.88 V07	9500	3	4
221.54 V02	1200	8	5
221.55 V02	1200	8	6
221.12 V03	1000	10	13
221.16 V03	1100	5	7
221.17 V03	11000	3	4
221.18 V02	11200	5	7
221.19 V02	1400	8	12
221.20 V02	4000	5	4
221.22 V02	1310	4	5
221.28 V02	9000	5	8
221.38 V02	n.a.	3	4

Table 3: Imbalance shut off

The shut off weight and speed may have slight fluctuations that depend on the unit and are therefore guidelines only.

7. Service Instructions

7.1 General technical description

Model **Z 32 HK** is a micro processor controlled cooled laboratory centrifuge.

The actuation is a three phase asynchronous motor which is controlled by frequency converter. Model **Z 32 HK** has an independent error detection program, displaying possible errors and therefore supporting the trouble shooting process.

The unit is equipped with several safety features:

- Imbalance detection
- Motor over temperature protection
- Lid lock does not open until the standstill of the centrifuge
- Rotor over speed protection
- Sample over temperature protection (50°C)

Please follow below mentioned safety instructions for any kind of service actions:

- The capacitor of the frequency converter can be under voltage even when the unit is switched off.
- Do not leave units unsupervised, when parts of the housing have been removed and the unit is still connected to the main power supply.
- Do not bypass the lid's safety contacts and never work with the unit's lid open.
- The VDE regulations are valid for all electrical work that has to be done.

7.2 Electrical and electronically components

7.2.1 Power board

The power board is serving the low voltage supply of the centrifuge control system with 5 V and 24 V. The power board is electrically isolated and has a dielectric strength of DC 2.2 kV.

Figure 1: Power board

7.2.2 Controal board (PCB)

The control board consists of one plate. The board can only be exchanged completely. If there is a defect you have to exchange the complete board. After a change, the control board is to be set new, depending on the model.

All signal lines lead to the control board.

The PCB controls the entire centrifuge.

Figure 2: Controal board

7.2.3 LCD Display

The following picture shows the individual elements of the LCD-display.

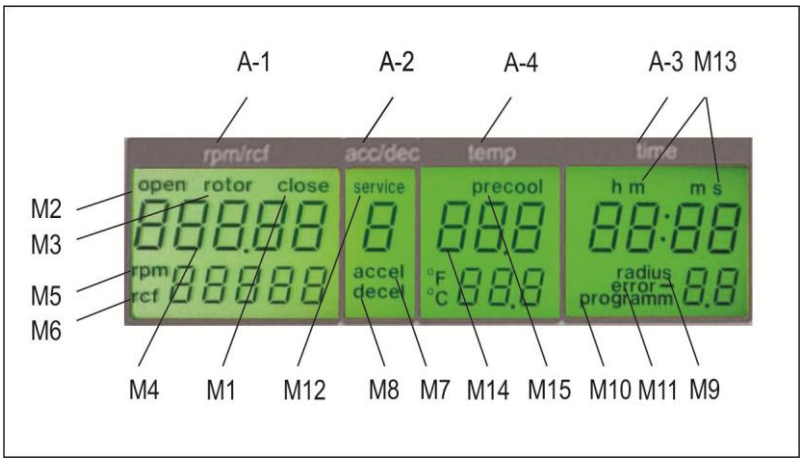

Figure 3: LCD-Display

Display fields:

A-1	Display field – „rpm/rcf“
A-2	Display field – „acc/dec“
A-3	Display field – „time“
A-4	Display field - „temp“

Messages/logos of the display fields:

M1	„close“	M8	„decel“	M15	„precool“
M2	„open“	M9	„radius“		
M3	„rotor“	M10	„program“		
M4	„rotor-No“	.M11	„error“		
M5	„rpm“	M12	„service“		
M6	„rcf“	M13	h m s		
M7	„accel“	M14	„temperature“		

7.2.4 Control panel

The control panel consists of one LCD-display, one potentiometer (1), the upper front housing and the foil keyboard. These parts can be exchanged separate. The potentiometer (1) regulates all parameters which are adjustable by pressing a key and which are indicated in the LCD-display. Inside the speed display of the control panel the error message is indicated if there occur any troubles.

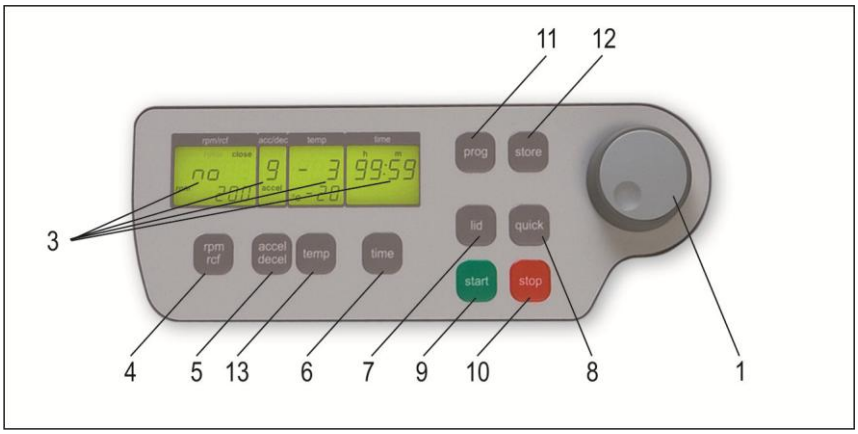

Figure 4: Control panel

1	**potentiometer**	run parameters
3	**LCD**	control panel display
4	**rpm/rcf**	speed/ g-force
5	**accel/decel**	acceleration- / Deceleration intensity
6	**time**	centrifugation time
7	**lid**	lid release
8	**quick**	short running
9	**start**	start centrifugation
10	**stop**	stop centrifugation
11	**prog**	calling stored programs
12	**store**	program store
13	**temp**	temperature store

7.2.5 Frequency converter

The frequency converter generates the drive signals for the asynchronous motor.

The converter leads the current generated by the motor during deceleration to a heating resistor to reduce the current.

The frequency converter is connected with the power board by a serial interface.

There is a green LED on the converter which flashes when the frequency converter is working correctly.

A defect of the converter will be indicated in the TIME display as an error no. (See chapter 8).

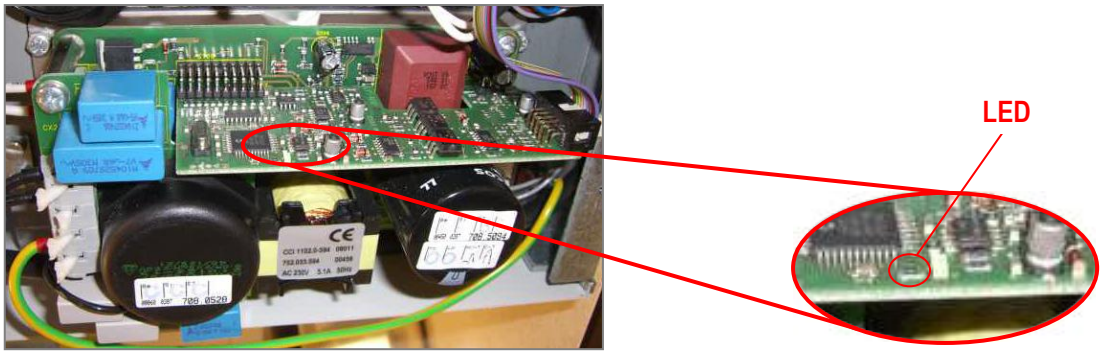

Figure 5: Frequency converter

7.2.6 Rotor recognition

The centrifuge will recognize the inputted rotor through the rotor identification transponder and the aerial belonging to it right after the insert automatically. As soon as the lid is closed the rotor number will be indicated in the speed display (see figure 3).

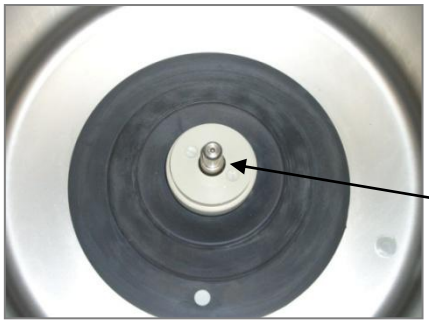

Figure 6: Aerial

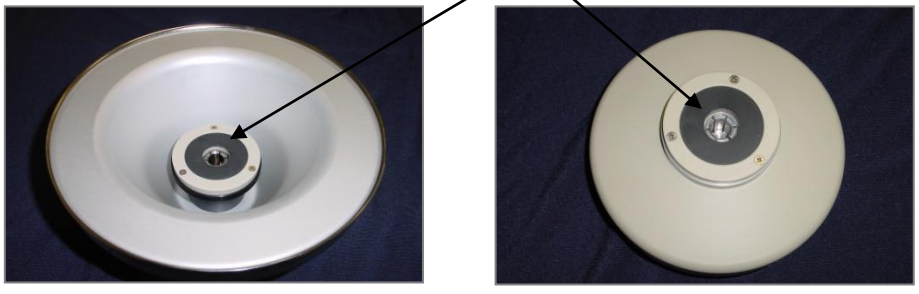

Figure 7: Below side of the rotor

7.2.7 Over speed protection

If the pre-selected rpm is higher as the permitted rpm of the rotor, the speed indication in the display will be regulated to the max. speed permitted for this rotor after the rotor recognition.

The regulation will accelerate the rotor only to the permitted rpm of the rotor.

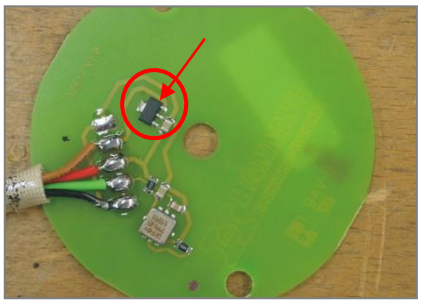

Figure 8: Over speed protection

7.2.8 Speed signal

The actual speed is extracted by a hall-effect-sensor placed on the lower side of the motor.

There is a “preset/actual“ comparison in the control board. Thereupon a new “preset-signal” is given by the control board to the converter (see figure 8).

7.2.9 Lid contact

The micro switch in the mechanism of the lid lock controls the correct closing of the centrifuge lid.
The switch may never be bypassed.
The lid lock is unlatched by an electro motor, receiving its signal from the control board.
The actual state is indicated in the display (M1, M2).

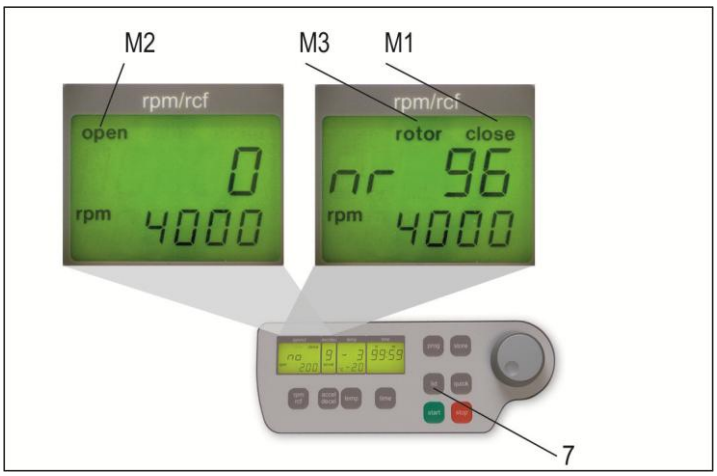

Figure 9

7.2.10 Imbalance detection

The imbalance detection is done in two ways.

A micro switch, controls for certain rotors, the displacement of the motor and shut off if there is too much imbalance. The micro switch should be adjusted according to the instruction of the company. (see chapter 7.4.13. and table 3).

A movement sensor, which is mounted underneath the motor, is controlling the oscillating motion of the motor. The unit stops when the oscillating motions are too strong. Setup data specified by the manufacturer for rotors controlled by the movement sensor cannot be changed.

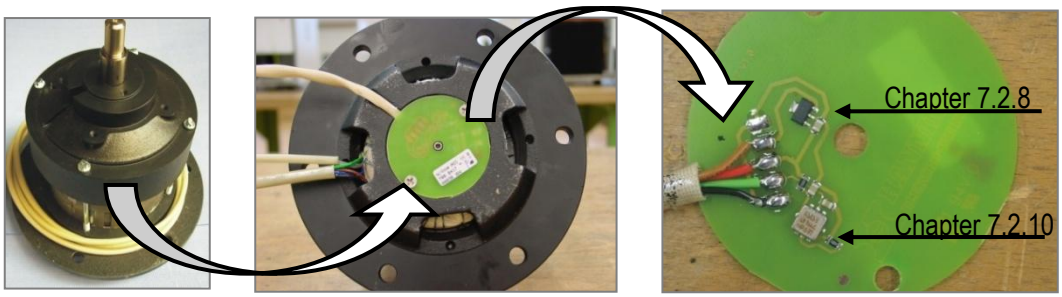

Figure 10: Imbalance detection

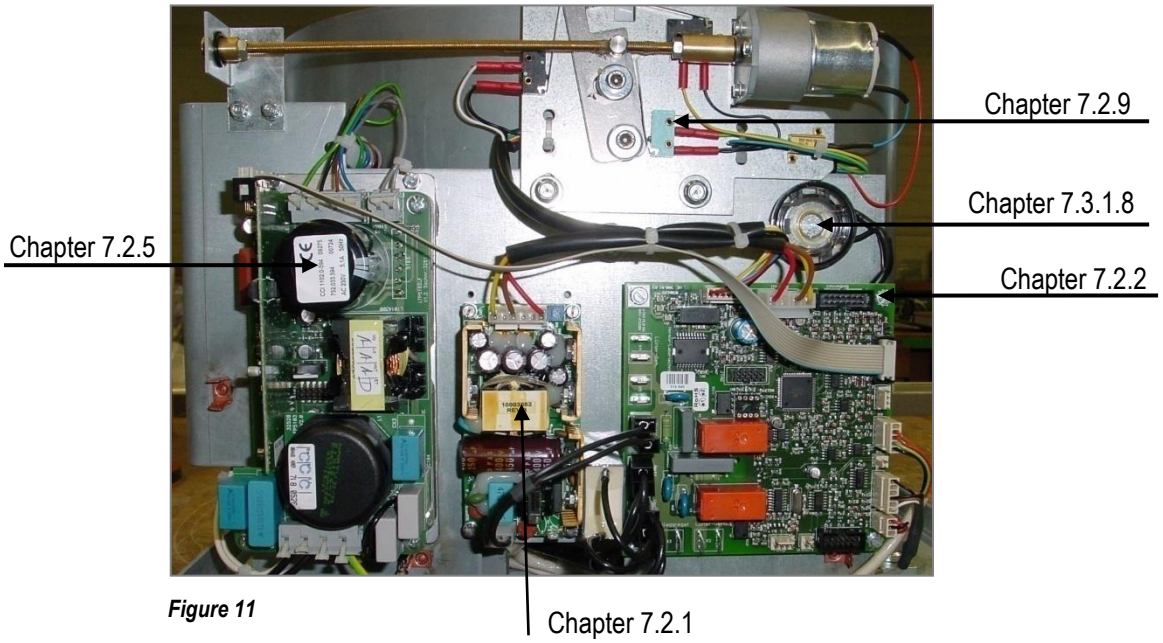

Figure 11

7.3 Operation menu

Valid for the units of the category with frequency converter.

The operation menu helps the service personnel to locate defects. It is divided in two parts, which are graded in several areas again from chapter 7.3.1 to 7.3.2.3.

Part 1 is accessible for the **USER** and different points can be read respectively settled. This is also described in the instruction manual.

Part 2 is for internal use respectively for trained service personnel outdoors Hermle LaborTechnik only. The control board can be adjusted to different units. Here the different parameters are determined on the respective unit after an **exchange** of the control board.

7.3.1 Activation of the operation menu (Part 1)

The menu can be started as follows:

- Open lid of the centrifuge and switch off main switch.
- Up to software version **1.24** press the key „time“ (6) and „prog“ (11) hold them and at the same time switch on the unit. From software version **1.25** please use the keys „time“ (6) and „lid“ (7). As you can’t know beforehand which software is installed in the unit, you have to try which combination will start operation menu (see therefore figure 4) .
- Find out by trying.

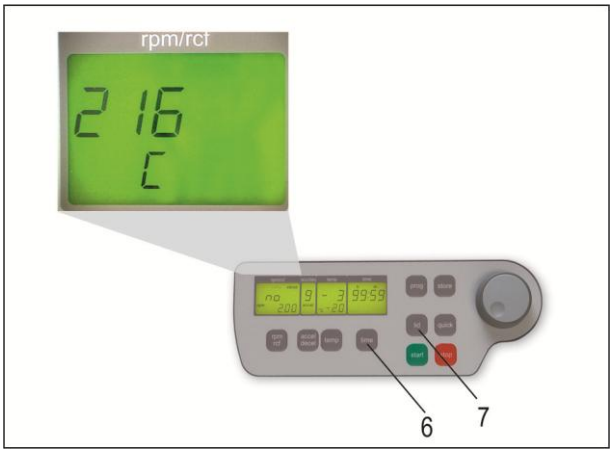

Figure 12: start menu

• After the indication displays flash on, led go off the keys „time“ (6) and „prog“ (11), resp. „time“ (6) and „lid“ (7).

In the display “rpm/rcf“ (4) the stored type of the centrifuge (i.e. **216,** see figure 12) and below a letter is indicated for about 2 seconds. The letter stands for the different versions of the units (see 7.3) which are currently stored in the control board:

C	for	cool
h	for	heat
no	for	nothing

Now it follows a display test for about 5 seconds as shown here under.

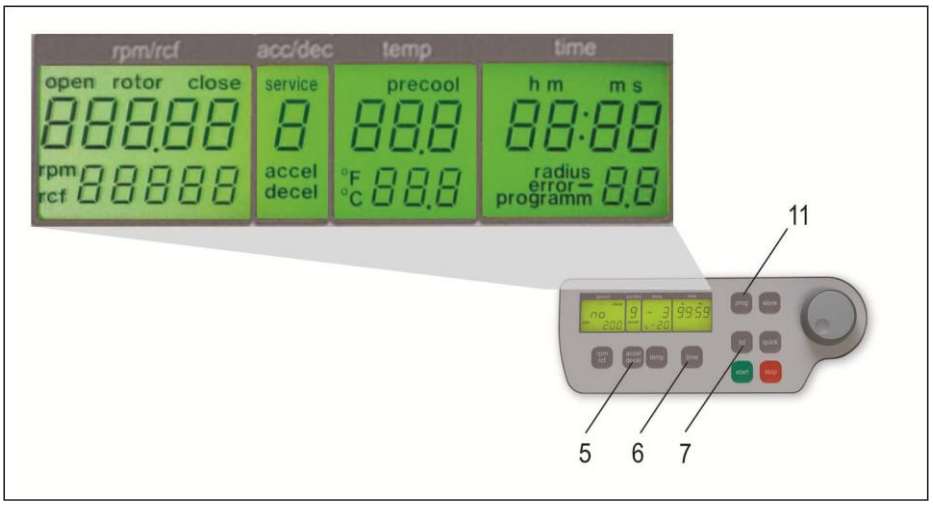

Figure 13: display test

Now you have entered the **Service mode**. By pressing the key „accel/decel“ (5) you will get to the submenus.

Now in the display “acc/dec“ (A-2) the word “service“ (M12) will flash. Only as long as this word is flashing, you can scroll through the further submenus with the potentiometer (1).

You have to repeat this step continously to enter the different submenus!

7.3.1.1 Submenu Motor starts

Here you can read off the number of motor starts.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service A“ appears in the display „acc/dec” (A-2), see figure 13.

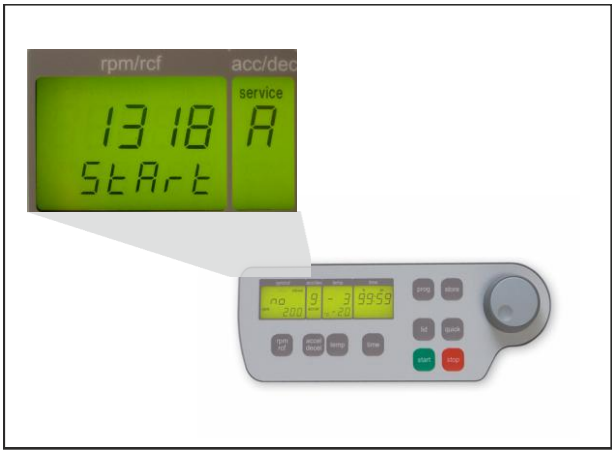

Figure 14

In the display “rpm/rcf“ (A-1) the number of motor starts is indicated now.

7.3.1.2 Submenu Duty cycle

Here you can read off the duty cycle of the unit.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service H“ appears in the display “acc/dec” (A-2).

Figure 15

Inside the display “rpm/rcf“ (A-1) now the duty cycle is indicated.

7.3.1.3 Submenu running time of the motor

Here you can read off the operating hours of the motor.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service h“ appears in the display “acc/dec”(A-2).

Figure 16

In the display “rpm/rcf“ (A-1) the running time of the motor is indicated now.

7.3.1.4 Submenu Software status

Here you can read off the software status.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit ”service S“ appears in the display „acc/dec” (A-2).

Figure 17

In the display “rpm/rcf“ (A-1) the actual software status is indicated now alternately with "Built"-No. and "Compilerversion". The Built-No and Compilerversion are exclusively for internal purpose.

7.3.1.5 Submenu Software status of the frequency converter:

Here you can read off the software status of the frequency converter.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit „service r“ appears in the display „acc/dec” (A-2).

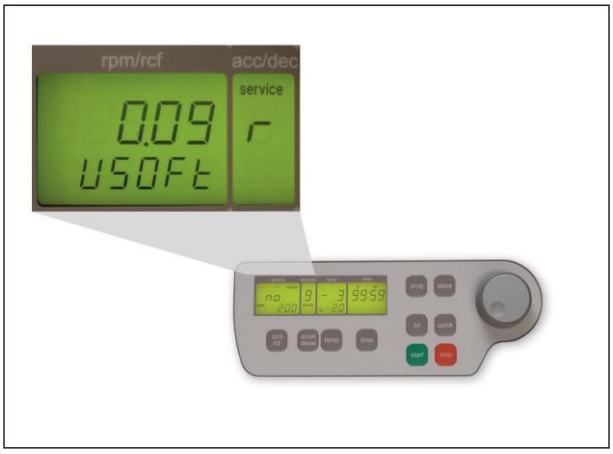

Figure 18

In the display „rpm/rcf“ (A-1) the actual software status of the frequency converter is indicated now.

7.3.1.6 Submenu Error Memory

Here the last 99 occurred error messages can be indicated.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service E“ appears in the display “acc/dec” (A-2).

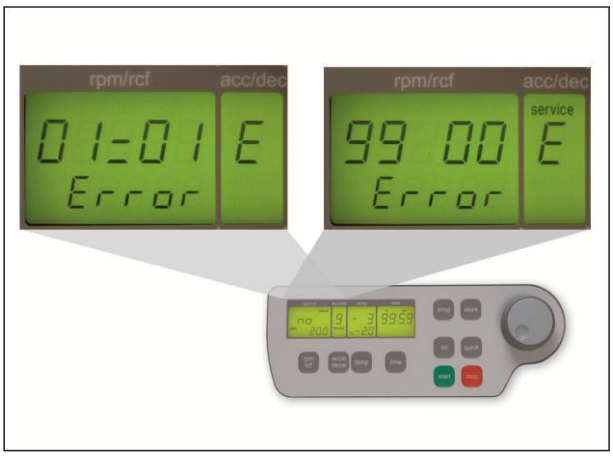

Figure 19

- By pressing the key „rpm/rcf“ (4) the display “rpm/rcf“ (A-1) is activated and you can scroll through the error list with the potentiometer (1).

- Now the last 99 occurred error messages are indicated in the display “rpm/rcf“ (A-1). Whereas the first two digits describe the place number and the last two digits do describe the occurred error. Look at chapter 8.2.3 "Errors that may be indicated in the LCD display".

7.3.1.7 Submenu Setup of temperature (for refrigerated units only)

Here you can change the temperature unit from degree Celsius (°C) to degree Fahrenheit (°F).

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service c“ appears in the display “acc/dec” (A-2).

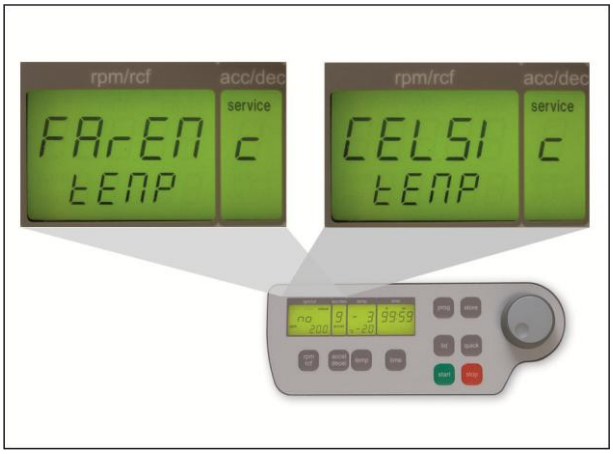

Figure 20

- By pressing the key rpm/rcf (4) the display “rpm/rcf“ (A-1) is now activated and you can setup the respective temperature unit with the potentiometer (1).
- Now the temperature is indicated in °C resp. in °F during the normal operation.

Attention: After all points have been reviewed and/or set up, you have to press shortly the key start (9) to store all parameters. Otherwise the setups were all for nothing. If the storage has been successful in the display “rpm/rcf“ (A-1) the value of the imbalance sensor and the word “StorE“ are indicated.

Figure 21

7.3.1.8 Submenu Setup of the loudspeaker

Here you can switch on resp. switch off the loud speaker (audible sound).

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service L“ appears in the display “acc/dec” (A-1).

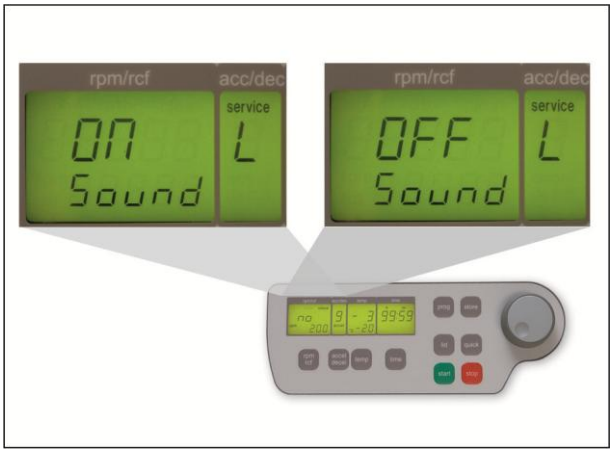

Figure 22

- By pressing the key rpm/rcf (4) the display „rpm/rcf“ (A-1) is now activated and you can setup the respective option with the potentiometer (1).
- Now the audible sound is activated resp. not activated by the end of the run or when an error message will occur.

Attention: In case that the loudspeaker is switch off, the keypad tone and the audible error message will also be suppressed.

The keypad tone has to be switched on again after the reactivation of the loud speaker. However the audible error message is automatically activated if the loud speaker has been reactivated.

Attention: After all points have been reviewed and/or set up, you have to press shortly the key "start" (9) to store all parameters. Otherwise the setups were all for nothing. If the storage has been successful in the display “rpm/rcf“ (A-1) the value of the imbalance sensor and the word “StorE“ are indicated.

Figure 23

7.3.1.9 Submenu Setup of the keypad tone

Here you can switch on resp. switch off the keypad tone.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service b“ appears in the display “acc/dec” (A-2).

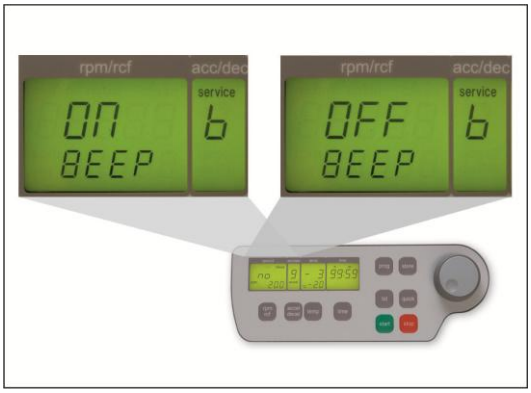

Figure 24

- By pressing the key rpm/rcf (4) the display “rpm/rcf“ (A-1) is now activated and you can setup the respective option with the potentiometer (1).
- Now the keypad tone is either activated or not activated.

Attention: In case that the signal is switched off, the keypad tone and the audible error message will also be suppressed.

The keypad tone has to be switched on again after the reactivation of the loudspeaker. However the audible error message is automatically activated if the loud speaker has been reactivated.

Attention: After all points have been reviewed and/or set up, you have to press shortly the key "start" (9) to store all parameters. Otherwise the setups were all for nothing. If the storage has been successful in the display “rpm/rcf“ (A-1) the value of the imbalance sensor and the word “StorE“ are indicated.

Figure 25

7.3.1.10 Submenu Setup volume of the loudspeaker

Here you can setup the volume of in case the loudspeaker is activated.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service u“ appears in the display ”acc/dec” (A-2).

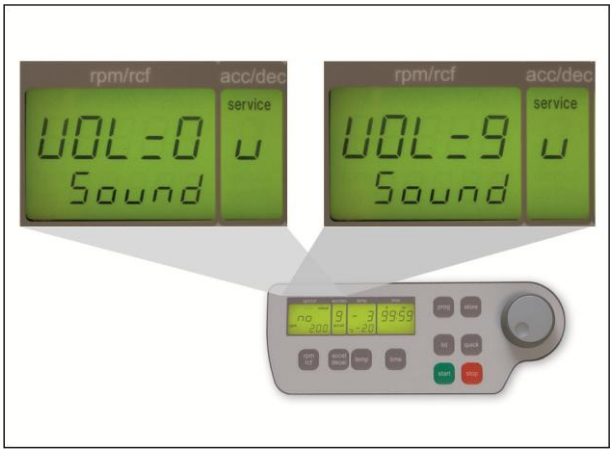

Figure 26

- By pressing the key rpm/rcf (4) the display “rpm/rcf“ (A-1) is now activated and you can setup the respective option with the potentiometer (1).
- At the end of the run you can now hear the setup volume whereas 0 is the most quiet setup and 9 the loudest one.

Figure 27

Attention: After all points have been reviewed and/or set up, you have to press shortly the key start (9) to store all parameters. Otherwise the setups were all for nothing. If the storage has been successful in the display “rpm/rcf“ (A-1) the value of the imbalance sensor and the word “StorE“ are indicated.

7.3.1.11 Submenu Setup of the signal melody

Here you can setup the volume of the loudspeaker in case the signal generator is activated.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service“ appears in the display ”acc/dec” (A-2).

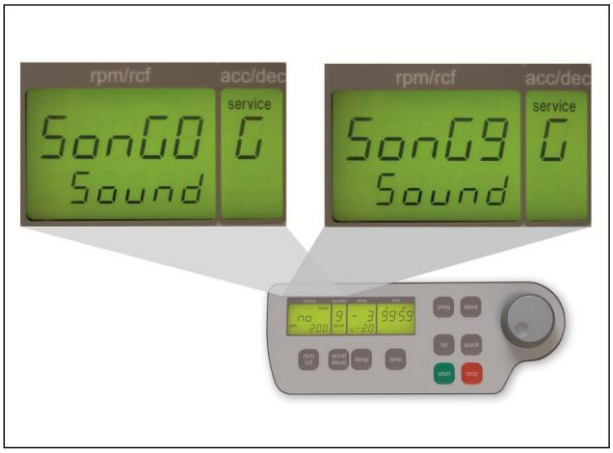

Figure 28

- By pressing the key rpm/rcf the display “rpm/rcf“ is now activated and you can setup the respective option with the potentiometer.
- At the end of the run you can now hear the audible sound in the setup volume whereas 0 is the most quiet setup and 9 the loudest one.

Attention: After all points have been reviewed and/or set up, you have to press shortly the key start (9) to store all parameters. Otherwise the setups were all for nothing. If the storage has been successful in the display “rpm/rcf“ (A-1) the value of the imbalance sensor and the word “StorE“ are indicated.

Figure 29

7.3.1.12 Submenu Check and calibration of the imbalance sensor (Movement sensor Setup of the signal melody

Here you can check or re-calibrate the imbalance sensor.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service F“ appears in the display “acc/dec” (A-2).

Figure 30:

- From software **1.59** the bottom line indicates the real current value. The value can be between "105-125" or "62-74", because of the different movement sensors.

- The **upper** value should be „C 115“ +/- 2 or at "C 0" + 2 liegen.

- At software versions under 1.59 you have to calibrate the movement sensor by pressing the key rpm/rcf. This have to be done, if the difference is too large. By that the upper line will also indicate "C 115" +/-2 or "C 0" +2 if the calibration was successful.

Attention: This setup should be done by service personnel only. During the calibration the unit should be placed at a flat table and shouldn't be moved.

- If the word "Error" appears in the display, the imbalance sensor is defective and you have to replace the whole rotary encoder board (mounted on the below side of the motor).

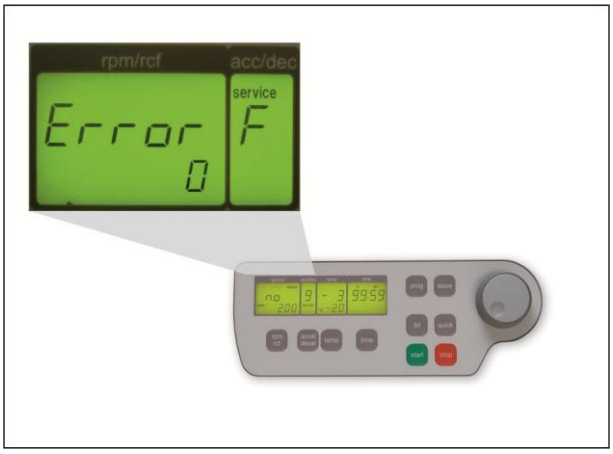

Figure 31

Attention: In case you have to replace the motor or the rotary encoder board for any reason, a new calibration is required **urgently**. The mechanical imbalance switch (micro switch) has to be re-adjusted, too. (see chapter 7.4.13)

Attention: After all points have been reviewed and/or set up, you have to press shortly the key "start" (9) to store all parameters. Otherwise the setups were all for nothing. If the storage has been successful in the display “rpm/rcf“ (A-1) the value of the imbalance sensor and the word “StorE“ are indicated.

Figure 32

7.3.1.13 Submenu Indication of the imbalance value of the rotor

Attention: To get access to this menu and read off the imbalance value, you have to close the lid of the unit before „**Activate the operation menu“**.

Here you can read off the imbalance value of the rotor transponder.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service Y“ appears in the display “acc/dec“ (A-2).

Figure 33

- In the bottom line of the display “rpm/rcf“ the real imbalance value is indicated. In the top line the rotor number is indicated (in this case 221.**17** V0?).

7.3.1.14 Submenu Keyboard test

The keyboard test is used for checking the correct function of the foil keyboard.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service P“ appears in the display “acc/dec“ (A-2).

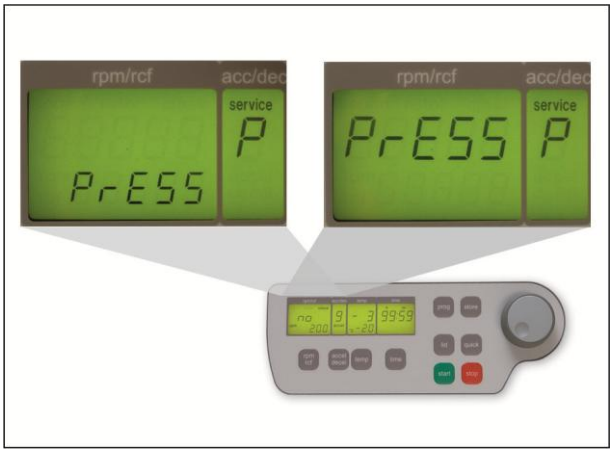

Figure 34

- By pressing each key the word “PrESS“ switches from the bottom to the top line in the display “rpm/rcf“ (A-2). The key accel/decel (5) excluded.

7.3.1.15 Submenu Indication of the revision number of the control panel; Check of the external imbalance sensor

Here you can read off the revision number of the control board. From the revision number 2 and the software version 1.33 on or higher, you have the possibility to check the function of the imbalance sensor.

- Activate the operation menu as described in chapter 7.3.1.
- Turn the potentiometer (1) until the special digit “service d“ appears in the display “acc/dec“ (A-2).

Figure 35

EXAMPLE:

Revision number 0, without automatically check

➡ see figure 35, left display.

Revision number 1, with automatically check (in this case (off))

➡ see figure 35, right display

7.3.2 Activation of the Service menu (Part2)

To get access to the second level of the service menu you have to press the key stop (10) for longer than one second. Now you are asked for a code in the display “rpm/rcf“ (A-2) – adjust the code “**9876**“ with the potentiometer (1) and press once again the key stop (10).

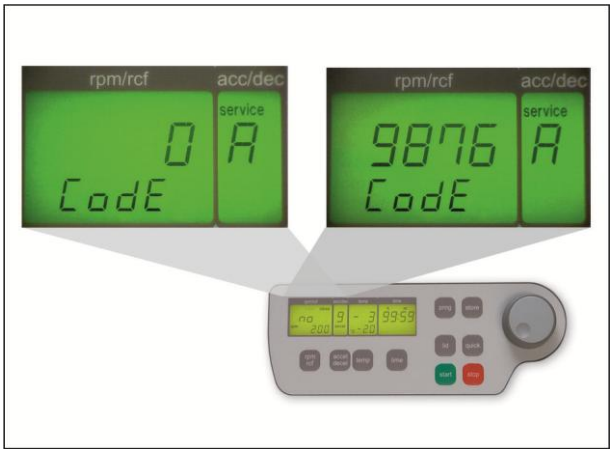

Figure 36

Now you can carry out the below shown adjustments:

7.3.2.1 Submenu Adjustment of the centrifuge type

Here you can adjust the different centrifuge types that are stored on the control board.

- Activate the operation menu as described in chapter 7.3.1.
- Activate the service menu as described in chapter 7.3.2.
- Turn the potentiometer (1) until the special digit “service t“ appears in the display “acc/dec“ (A-2).

  Examples:

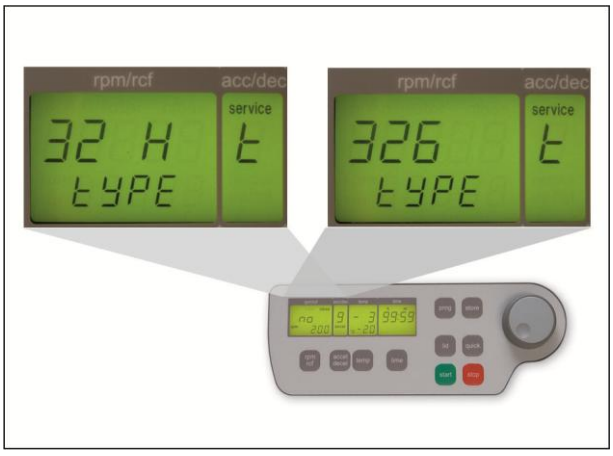

Figure 37

- By pressing the key rpm/rcf (4) the display “rpm/rcf“ (A-1) is now activated and you can setup the respective option with the potentiometer (1).

⚠ **Attention**: Please do not adjust any other centrifuge types than the mentioned one on the type label of the unit. Otherwise there might the possibility to occur defects, either in the electronic and/or the mechanic components.

Attention: After all points have been reviewed and/or set up, you have to press shortly the key start (9) to store all parameters. Otherwise the setups were all for nothing. If the storage has been successful in the display “rpm/rcf“ (A-1) the value of the imbalance sensor and the word “StorE“ are indicated.

7.3.2.2 Submenu Adjustment of the operation mode

Here you can adjust the different operation modes stored on the control board.

- Activate the operation menu as described in chapter 7.3.1.
- Activate the service menu as described in chapter 7.3.2.
- Turn the potentiometer (1) until the special digit “service C“ appears in the display “acc/dec“ (A-2).

  Do not confuse with “c“ **Submenu Setup of the temperature.**

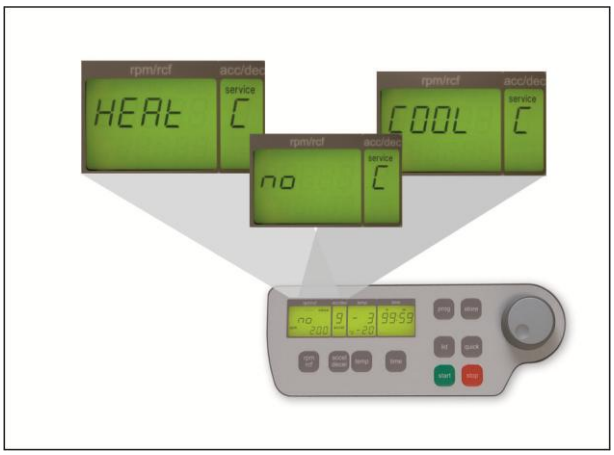

Figure 38

- By pressing the key rpm/rcf (4) the display “rpm/rcf“ (A-1) is now activated and you can setup the respective option with the potentiometer (1).

- As we have already mentioned in the beginning this letters will appear when you switch on the unit during the normal operation (see chapter 7.3.1).

7.3.2.3 Submenu Adjustment/Correction of the imbalance cut off value:

From software version 1.60 you can adjust or correct the imbalance cut off value. In the factory has been setup an imbalance cut off value. With this settled value the unit should run through. Through the transport or the setup of the unit it may occur that this value will react unlike.

In case the unit does already cut off at the adjusted value you can increase this value by adjusting this value > 0. In case the unit does not cut off until you can decrease this value by adjusting this value < 0. The suitable value must be settled by service personnel only.

After the correction there is another check indispensable. You have to make several tests.

- Activate the operation menu as described under 7.3.1 **„Activation of the operation menu (Part 1)“**.

- Activate the operation menu as described under 7.3.2 **„Activation of the service menu (Part 2)“**.

- Press the button "accel/decel" (5). Turn the potentiometer (1) until the special digit „U“ appears in the display "acc/dec" (A-2) (see figure 39).

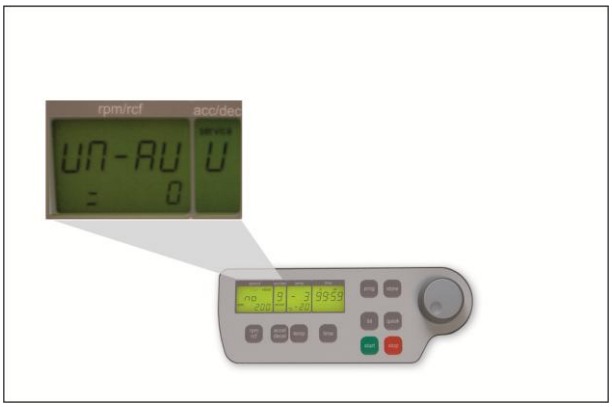

figure 39

- Press the button "rpm/rcf" (4). The display "rpm/rcf" (A-1) is now activated and you can choose the respective setup between -30 and 20 with the potentiometer (1).

  Attention: After all points have been reviewed and/or set up, you have to press shortly the key "start" (9) to store all parameters. Otherwise the set ups where all for nothing. If the storage has been successfull in the display "rpm/rcf" (A-1) the value of the imbalance sensor and the word "storE" are indicated.

-

7.3.2.4 Submenu Activating/Deactivating of the electronical Imbalance

If you want to adjust the mechanical imbalance switch (see chapter 7.4.13), then you have to switch off the electronic movement sensor as follows:

- Activate as described under 7.3.1 **„Activation of the operation menu" (Part 1)**".
- Activate as described under 7.3.2 **„Activation of the service menu (Part 2)"**.
- Press the key "time" (6). In the display "rpm/rcf" (A-1) the word "b-SEN, AUS" (see picture 40) is now indicated. **The electronic imbalance detector is now not longer activated!**

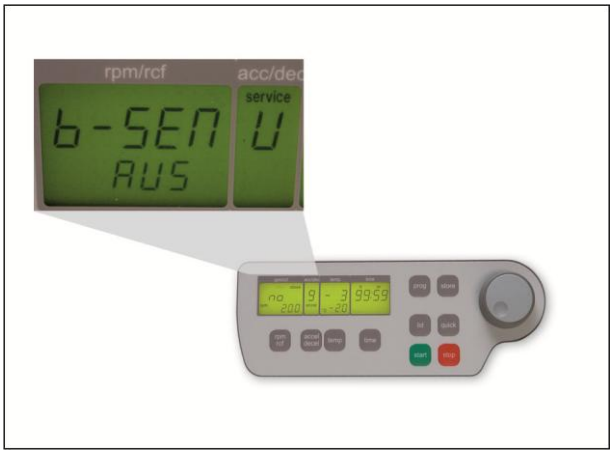

figure 40

- Turn the device off and turn it on again. The word "UA" appears now in the display "time" (A-3), see picture 41. Now you can adjust the mechanical imbalance detector, see chapter 7.4.13 "Adjustment of the mechanical imbalance detector".

figure 41

7.4 Mounting support

After performing any kind of assembling work, please make sure all the grounded contacts are connected correctly!

7.4.1 Replacing the front housing, the potentiometer and the display

Replacing the front housing

- Remove the lower covering by turn out the 2 screws (see figure 42).
- Pull the lower edge of the covering away from the mounting plate.
- Pull the covering out of the upper guiding rail.
- Loosen the 5 screws under the control panel and pull away the panel forward (see figure 43). Use therefore the pictured tools.

  Remove the interface cable on the control board (connection between control board and control panel).

Figure 42

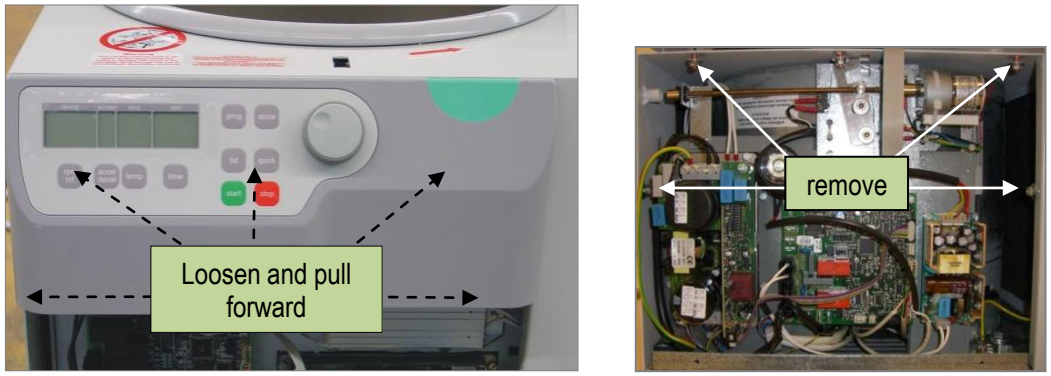

Figure 43

7.4.2 Replacing the potentiometer

- Remove the cap on top of the potentiometer (see figure 44).
- With a socket wrench you can loosen the fastening nut.

Figure 44

- Loosen all electrical contacts to the shaft encoder on the back side of the front housing.

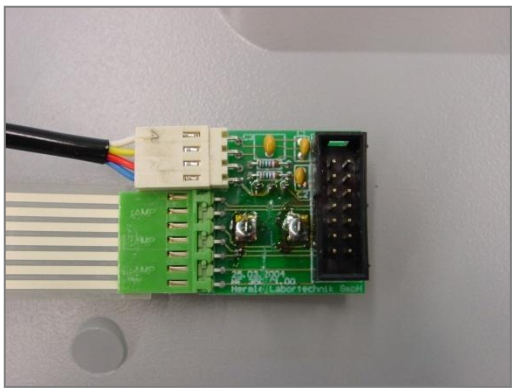

Figure 45

7.4.3 Replacing the display

- Loosen all electrical contacts to the display on the back of the front housing.
- Remove the 4 fastening screws of the display and pull away the display upwards.

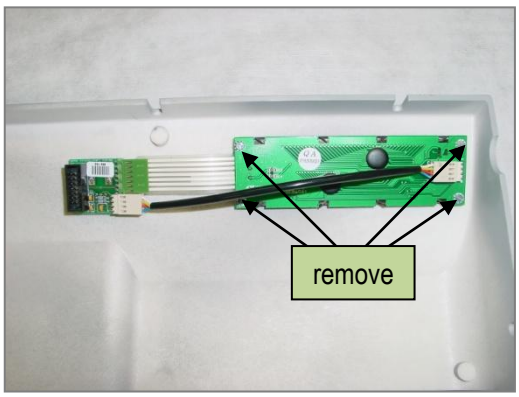

Figure 46

7.4.4 Replacing the foil keyboard

Remove the potentiometer and the display.

- Peel off the defective foil keyboard and clean the remaining glued joints.

- Glue the new foil keyboard precisely in the recess.
  Make sure the foil matches precisely and the window of the foil keyboard lies exactly over the display.

Attention: Do not use already glued keyboard foil again!

- Reassemble the control panel in reversed order and mount it back in the front housing.

7.4.5 Removing the housing

- Remove the control panel as described in chapter 7.4.1.
- Remove the back wall plate and its electrical ground.

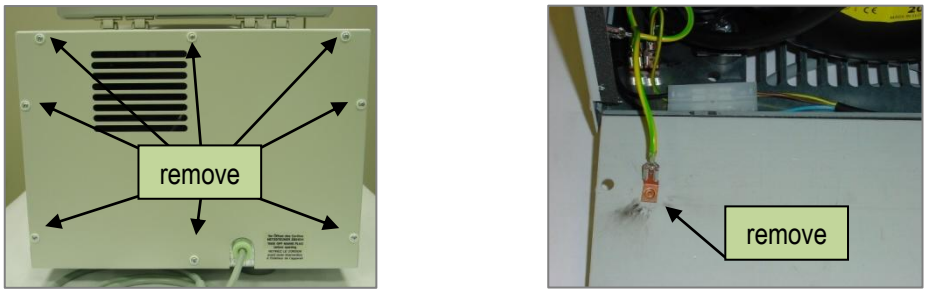

Figure 47

- Remove all screws on the left/right side of the housing and its electrical grounding.

Figure 48

- Remove the housing upwards.
- Reassemble the unit in reverse order.
- Make sure the lid sealing, which is also the rotor chamber sealing, is placed correctly. You can use a small allan key.

Push it between sealing and rotor chamber. Pull the sealing in a circular movement towards the chamber's centre. (See chapter 7.4.6.)

Figure 49

7.4.6 Replacing the lid gasket

- Remove the lower covering of the front housing and remove the screws of the housing as described in chapter 7.4.1 and 7.4.5.
- Open the lid as wide as possible.
- Pull the housing slightly upwards until the lid gasket is freely accessible.
- Now remove the old lid gasket. **ATTENTION**: The lid gasket is glued at some points in case you want to reuse the same gasket you have to loosen the glued points carefully to avoid any damage.
- Reassemble the unit in reverse order.
- Take care that the fixing ends are at the back part of the chamber. Start the mounting always with this glued ends. You can use a small Allan key. Push it between sealing and rotor chamber (see figure 49). Pull the sealing in a circular movement towards the chamber's centre (see chapter 7.4.5.).
- If replacing the lid gasket of an elderly unit, please make sure, that the cutting of the chamber sealing, which is responsible for air ducting, is not covered.

7.4.7 Removing the lid

Open the lid as wide as possible.

- Remove the back wall plate as described in chapter 7.4.5.
- Hold the lid with one hand and remove the fixing screws of the hinges.
- The lid can now be removed completely.

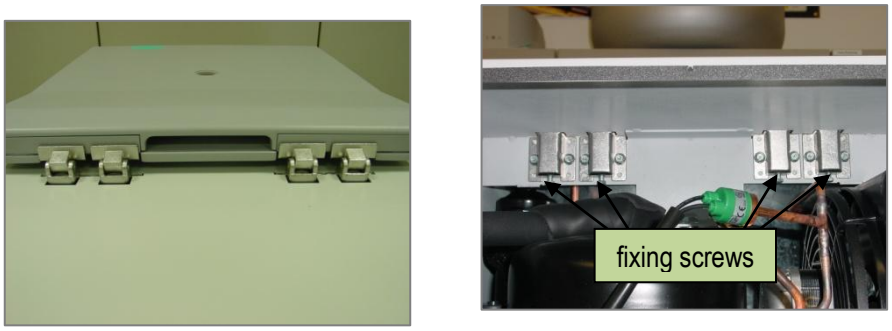

Figure 50

7.4.8 Replacing the hinges

Remove the lid as described in chapter 7.4.7.

- Lay the lid with the upper side down on a smooth under packing to avoid any scratches.
- Loosen the screws of the respective hinges on the inner side of the lid.

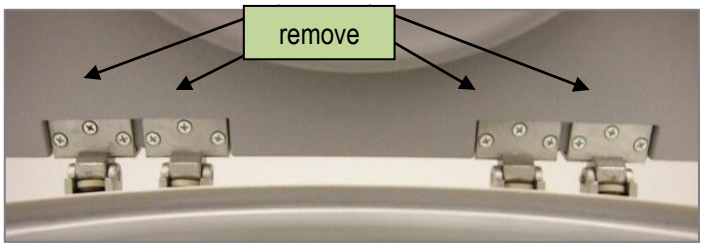

Figure 51

- Reassemble the unit in reverse order.
- Make sure the lid rests on the lid gasket straight and continuous. Tighten the fasting screws firmly at the backside of the unit after the adjustment.

7.4.9 Replacing the aerial (rotor sensor)

- Remove the motor rubber covering by pulling it out simply.
- Remove the screws of the aerial.

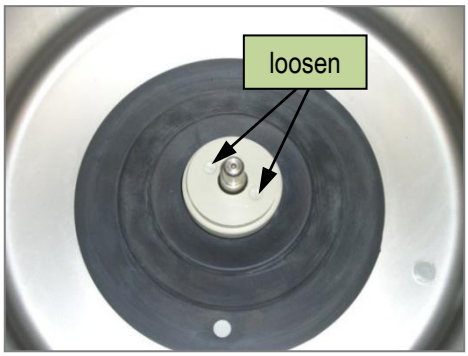

Figure 52

- Remove the lower covering of the front housing as described in chapter 7.4.1.
- Remove the connection cable on the control board and remove the aerial.

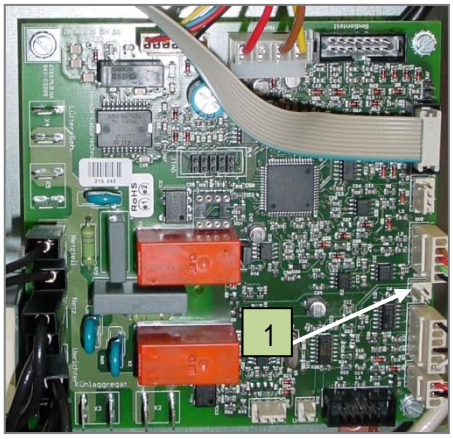

Figure 53

- Put in the new aerial.
- Reassemble the unit in reverse order.
- Only use plastic screws, otherwise there can trouble occur.

7.4.10 Replacing the motor resp. the motor rubber bearings

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove the connection cables to the motor on the control board and the frequency converter.

1) Motor temperature (on the frequency converter)

2) Current supply motor (on the frequency converter)

a) U2 = black b) V2 = Brown

c) W 2 = blue d) Ground

This is a clamp system. Make sure, that after new connections the wives are clamped between the points

3) Speed and imbalance sensor (on the control board)

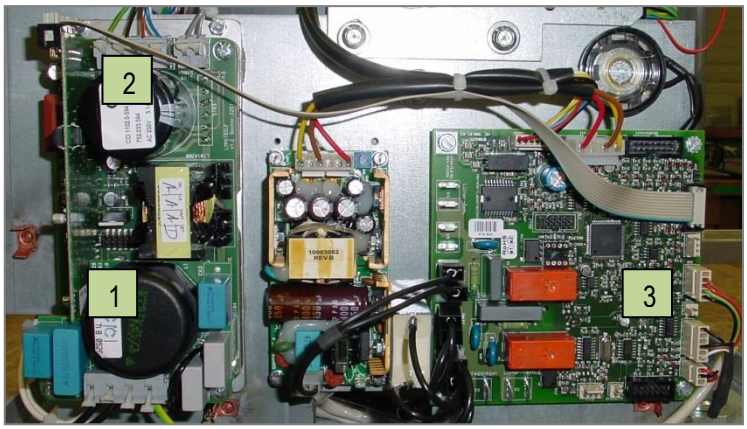

Figure 54

- Remove the areal as described in chapter 7.4.9.
- Remove the screws from the motor fixing.
- Lift the motor out of the unit.

Figure 55

- When reassembling the spare motor, take care of the wirings, as they must not be jammed.
- When tightening the motor mount screws, please pay attention the motor rubber mounts are not being twisted.
- When connecting the motor with the electricity, take care of the rotating direction (Direction of arrow).
- Reassemble the unit in reverse order.

Replacing the motor rubber bearings

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove the motor as described above.
- Tilt the unit a little bit and remove the screws of the motor rubber mounts.
- Put in the new motor rubber mounts and reassemble the unit in reverse order.

- Take care that the motor is placed straight and centered in the rotor chamber. The distance of the center of the motor shaft to the wall of the rotor chamber must be strictly adhered. When tightening the motor rubber mounts, also take care that they are not being twisted.

Attention: After are placing of the motor look to chapter 7.3.1.12

7.4.11 Replacing the power board

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove all cable connections to the power board.
- Remove the four fixings screws.

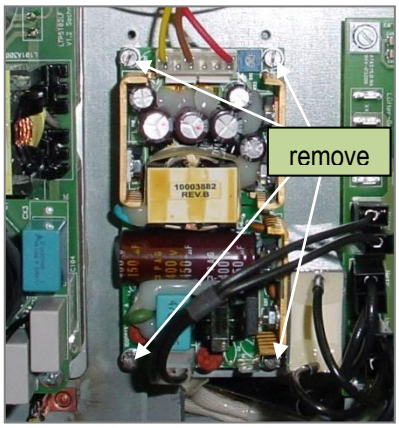

Figure 56

- Reassemble the unit in reverse order.

7.4.12 Replacing the frequency converter

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove all cable connections to the frequency converter.
- Remove fixing screws as shown on the below picture and remove the frequency converter from the unit.

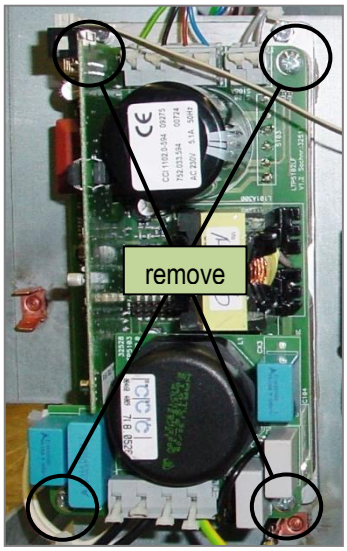

Figure 57

Attention: Before placing a new converter into the unit, put some heat conducting paste onto the fixing surface. Reassemble the unit in reverse order.

7.4.13 Checkup the imbalance sensor

Movement sensor:

- From software version 1.60 it is possible to adjust/correct the imbalance value see chapter 7.3.2.3
- Should appear any difficulties with the imbalance, please give us an exact description of it as well as the serial number of the unit and the rotor type.
- You can check up the imbalance sensor with the operation menu. Look up in chapter 7.3.1.12.

Replacing the imbalance - (movement sensor) and speed sensor

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove the motor as described in chapter 7.4.4.
- Lay the motor down on its side and remove the two fixing screws of the green circuit board on the rear side (look up in chapter 7.2.8).
- Replace the board and reassemble the unit in reverse order.
- After reassembling everything, do a new calibration as described in chapter 7.3.1.12

Mechanic micro switch:

Replacing the imbalance micro switch

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove the housing as described in chapter 7.4.5.
- Remove all defective parts as imbalance micro switch, angles or spring plates.
- Adjust the imbalance micro

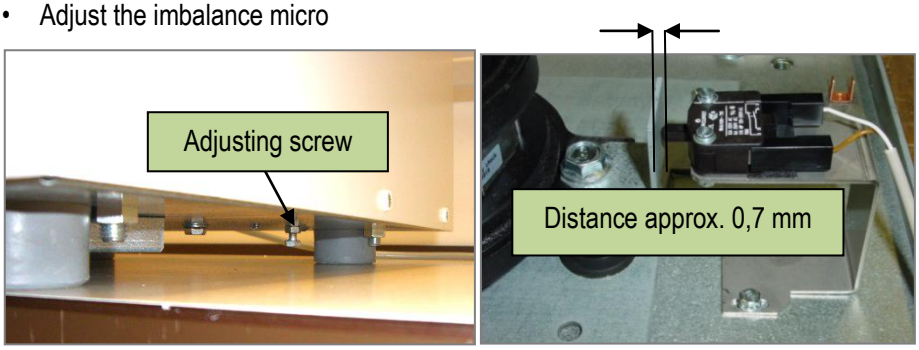

Figure 58

Adjustment of the imbalance micro switch

- Shut off the movement sensor first, as descript in 7.3.2.3
- Put a rotor into the unit and fasten the rotor nut.
- Load one hole of the rotor with the listed imbalance shut off weight in table 6.3.
- Adjust the acceleration- (accel) and the deceleration level (decel) on the control board to level 9.

- Start the centrifuge. The unit must shut off when reaching the listed speed of the resp. rotor (see table 3)
- In case the unit does not shut off you have to loosen the fixing screws of the imbalance sensor. Adjust the imbalance sensor more sensitive with the adjusting screw (clockwise).
- Repeat those steps as often as the listed value of the table 6.3 is reached.
- Switch off the unit with error message 01 and fill the rotor with the permitted imbalance weight.
- The unit must not shut off after the start. In case the unit shuts off, you have to lower the sensibility of the sensor.
- In case you have to readjust the imbalance sensor when testing the permitted imbalance weight, you have to repeat the procedure with the imbalance shut off.
- Turn the unit off and on -> the movement sensor is turned on again.

7.4.14 Replacing the control board

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove all electrical connections on the control board.
- Remove the 4 screws and remove the control board.

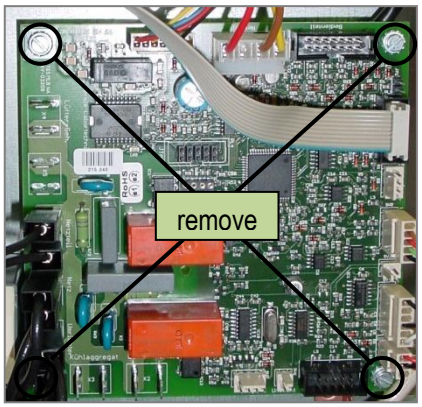

Figure 59

7.4.15 Replacing the break resistance

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove the screws and the center screw of the electronic components mounting plate. Upon this there are fixed the electronically components.
- Remove the electrical connections of the break resistance to the frequency converter.
- Tilt the mounting plate forwards.

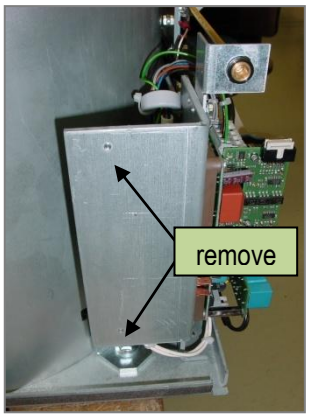

Figure 60

- Remove the 2 screws on the backside of the mounting plate and remove the break resistance.
- Put in the new break resistance, connect the electrical connections. The electrical connections are changeable. Reassemble the unit in reverse order.

7.4.16 Replacing the signal generator

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove all electrical connections on the control panel (1, see figure 61).

Figure 61

- Go with a flat, sharp item (knife or screwdriver) under the signal transmitter and lift it up with slight efforts.
- Fix the new signal transmitter with double-sided adhesive tape and reassemble the unit in reverse order.

7.4.17 Replacing the lid lock

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove the electrical supply on the control board (1, see figure 62).

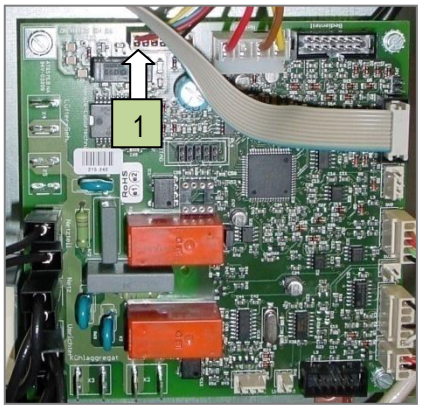

Figure 62

- Remove the two fixing screws of the lid lock and put in the new lid lock.

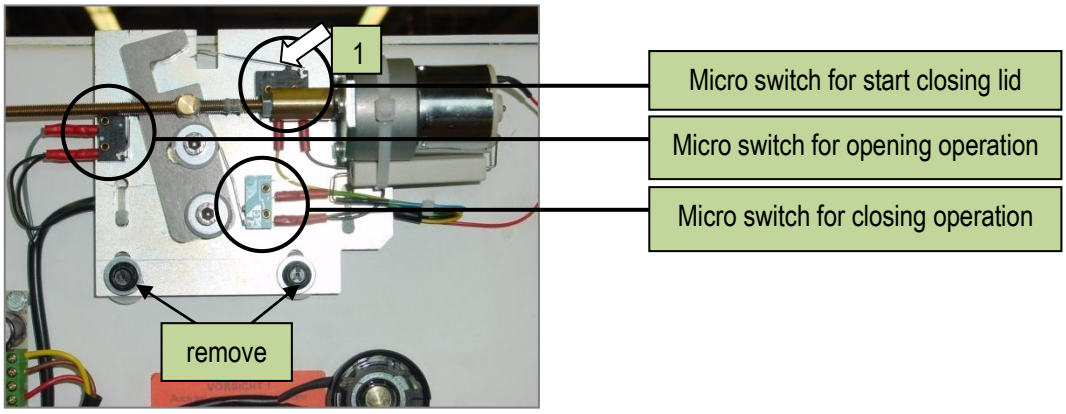

Figure 63

- Keep attention through adjustment of the lid lock, that the lid lies straight and continuous on the lid sealing. After adjustment tighten the screws well.

Adjustment:

1.) Lay the lid onto the centrifuges seal. Afterwards tighten the screws of the hinges under a little pressure onto the lid.

2.) Put some washers underneath of the lid lock, in that way that the lid latch is centric to the closing bar.

3.) Adjust the high of the lid lock, that the distance between the lid and the housing is about 8 mm to 9 mm.

4.) Bent the steel nib of the upper micro switch (1, figure 63) in that way, that it is given the signal after the lid latch has pressed the steel nib under the level of the bar. The motor of the lid lock

should not be blocked during the closing of the lock. Otherwise you have to repeat the steps 3.) and 4.).

5.) Perhaps you have to bend the steel nibs of the other micro switches of the end stops into their position.

6.) Tighten all the screws well.

7.4.18 Replacing the temperature sensor

- Remove the covering of the front housing as described in chapter 7.4.1.
- Remove the electrical supply on the control board (1, see figure 64)

Figure 64

- Remove the motor rubber covering by pulling it out simply.

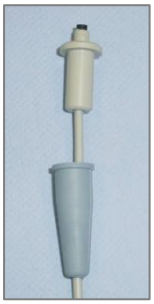

Figure 65

- Pull out the temperature sensor from the rubber motor cover. Hold therefore the underneath rubber nose, which held the sensor housing in its position. Press afterwards the rubber nose together and push it towards the hole.
- Reassemble the unit in reverse order.

7.5 Refrigeration system

7.5.1 Functional description of the refrigeration system

The expansion valve regulates how much refrigerant is being led to the evaporator. The compressor makes the refrigerant available in the collective dryer. A sensor is continuously measuring the temperature at the evaporator output. Through this, the injection nozzle of the expansion valve is controlled and the evaporator is supplied with the max. necessary amount of refrigerant. Therefore, maximum capability of the refrigeration system can be reached at any status of operation.

As soon as the required pre-set temperature is reached, the compressor will switch off. When the temperature rises again, the compressor will switch on again.

The response time of the compressor is controlled with a microprocessor control. The processor receives the chamber temperature data through a temperature sensor placed in the rotor chamber. As the actual sample temperature may not be identical to the temperature measured in the rotor chamber, the micro processor will calculate the sample temperature for the rotor in use. This temperature value is indicated in the temperature display.

The temperature adjustment of the micro processor is based on this calculated temperature value. Therefore, the user always gets the exactly requested sample temperature (± 1°C). The samples are not being damaged through over or lower temperature.

7.5.2 Refrigeration scheme

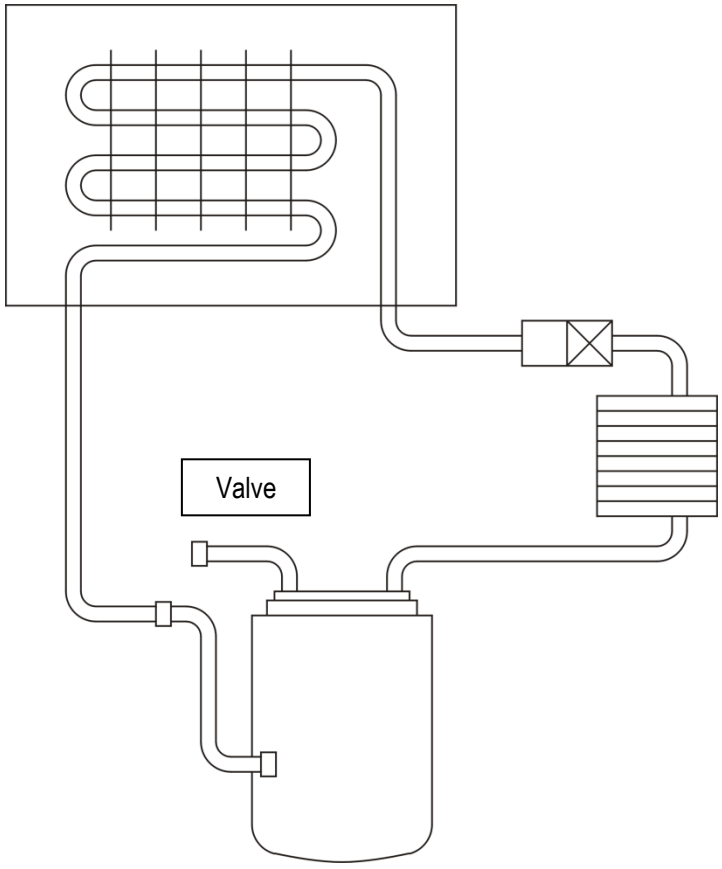

Figure 66

7.5.3 Emptying and filling the refrigeration system (refrigerant R 404 a)

For this performance you need a refrigerant suction plant with container, a vacuum pump, a vacuum measuring device, a measuring device for refrigerants and a manometer combination.

The refrigeration system has the CFC-free refrigerant type R 404 a.

Emptying the refrigeration system:

- Remove the housing, until the refrigeration set is exposed (see chapter 7.4.5.)
- Connect the suction plant to the valve (see figure 67).
- Remove the refrigerant from the system.
- You can now perform necessary repairs.

Filling the refrigeration system:

- Connect the vacuum pump, the manometer combination and the refrigerant bottle (R 404 a) to valve 1 (see figure 67).
- Evacuate the refrigeration system for approx. 30 min.
- Switch off the vacuum pump.
- Make sure that the reached vacuum stays constant after switching the pump off, otherwise the system is leaky.
- Fill the refrigeration set with **550 g** refrigerant type R 404 a.
- Check all tube connections with a leakage detection device for possible leakage.

ATTENTION:

You must use refrigerant type R 404 a only!

Filling amount is 550 g!

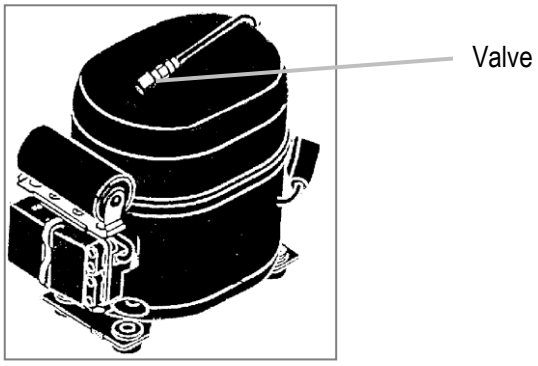

Figure 67: Example

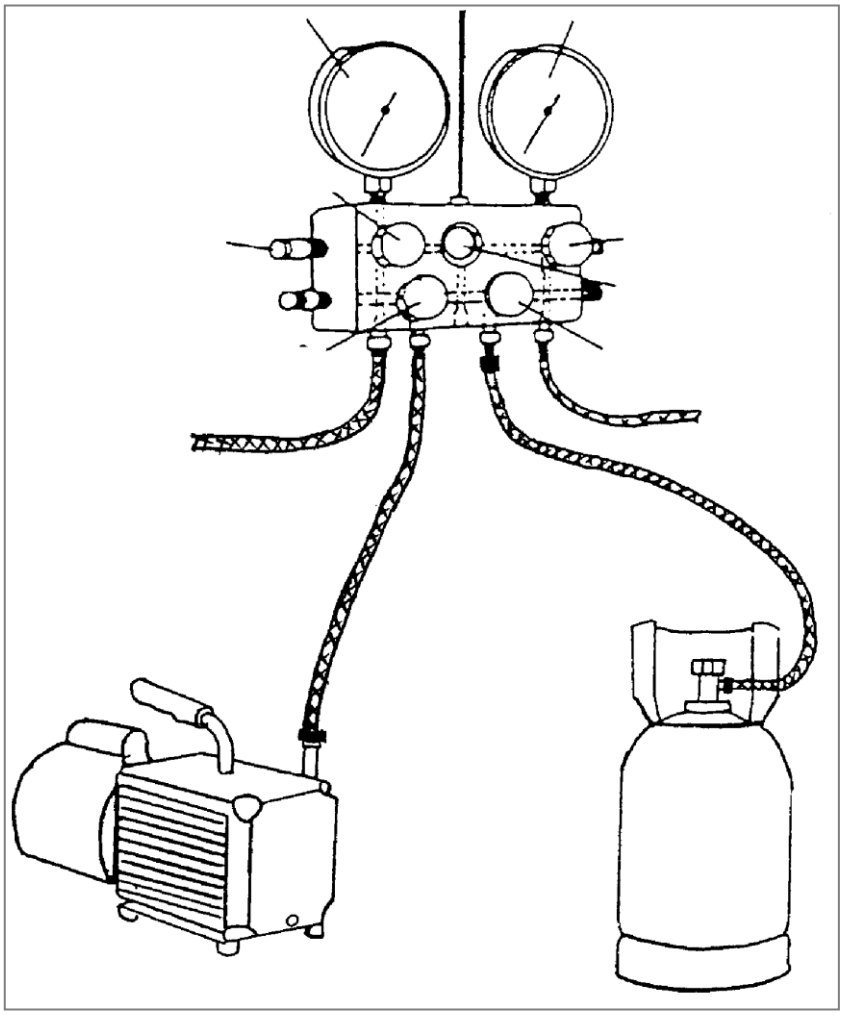

Figure 68

8. Trouble Shouting

8.1 Error messages: Cause / Solution

Preface:

The error messages are listed to help localize possible errors faster.

The diagnosis, referred to this chapter may not always be the case, as they are only theoretically occurring errors and solutions.

Always, please keep us informed about any kind of error occurring, which is not listed in this chapter. Only through your information we are able to improve and complete this instruction manual.

Many thanks in advance for your support.

HERMLE Labortechnik GmbH

8.2 Survey of possible error messages and their solutions

8.2.1 Lid release during power failure

In case of power failure or malfunction, the lid of the centrifuge can be opened manually in order to protect your samples.

Please proceed as follows:

- Switch the centrifuge off and unplug the power cord.
- At the left side of the centrifuge there is a plastic stopper.
- Remove this stopper. Behind there is a hexagon nut.
- Take the delivered box spanner, put it in the hole and lock the box spanner with the hexagon nut.
- Now turn the box spanner to the right side (clockwise) up to the limit.
  ATTENTION: Just turn to the limit, don't tighten the nut.
- Now open the lid of the centrifuge and take out the box spanner.
- Switch the centrifuge on again, for go on working.

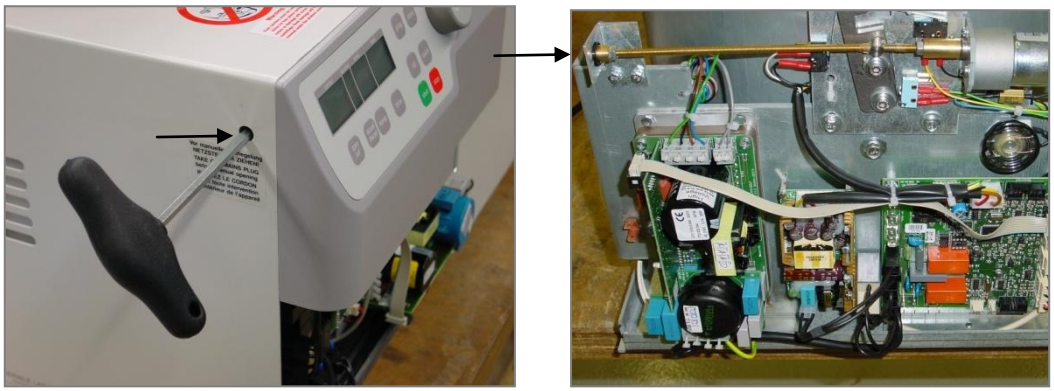

Figure 69

8.2.2 Description of the error message system

The error message is shown in the "time" display through particular figures. At the same time the word “error“ is indicated in the display (see figure 70).

Figure 70

8.2.3 Errors that may be indicated in the LCD display

Error No.	Description	Cause
01	Imbalance arose	Excessive acceleration at the sensor
02	Imbalance sensor is defective	Rotary encoder circuit board is defective, cable break, plug is loose (between control unit to frequency converter), control unit is defective. From control revision no.2 it may also be the power supply or the four-pole connection cable to the defective control unit.
04	Imbalance switch has been activated for longer than 5 seconds	Imbalance switch incorrectly adjusted, imbalance switch is defective, cable break, plug is loose (between control unit to frequency converter), control unit is defective
08	Transponder in the rotor is defective or incorrect/missing data in the in the rotor database	The transponder in the rotor disk has a fault in memory. It can also be an error in the memory of the microcontroller.
11	Temperature sensor is defective	Temperature sensor is defective, cable break, plug is loose (between control unit to frequency converter), control unit is defective.
12	Chamber over temperature	Relay on the controller is defective, cooling is defective, heating is defective, ventilation is defective.
14	Problem with the speed sensor. Lid is closed for a certain time. The blocking time is shown in the display and replaced with **"CLOSE Lid"**. (From 10.06.09 Version 1.33)	Rotary encoder circuit board is defective, cable break, plug is loosen (between control unit to frequency converter), motor is blocked, control unit is defective, frequency converter is defective.
33	Open lid while rotor is running	Lid has been opened during rotating with the emergency release, control switch of the lid lock is defective, cable break, plug is loosen (between control unit to frequency converter), control is defective.

34	Lid contact defective	Control switch of the lid lock is defective, cable break, plug is loosen (between control board to frequency converter) , control is defective.
38	Lid motor is blocked - the lid lock is blocked for 30 sec.(from 08.10.08 Version 1.26)	Lid interlock was held, lid motor is defective, control switch of the lid lock is defective, cable break, plug is loosen (between control board to frequency converter), control is defective.
40	Communication with frequency converter disturbed during start (Position request not understood at the start)	At revision no.1 it could be, that the frequency relay is defective, cable break, plug is loosen (between control to frequency converter), frequency converter is defective, control is defective
41	Communication with frequency converter disturbed during start (Position request not understood at the stop)	At revision no.1 it could be, that the frequency relay is defective, cable break, plug is loosen (between control board to frequency converter), frequency converter is defective, control is defective
42	Short circuit in the frequency converter	Frequency converter defective, motor defective
43	Under voltage frequency converter	Brief power failure, At revision no.1 it could be, that the frequency relay is defective, cable break, plug is loosen (between control board to frequency converter)
44	Over voltage frequency converter	Break resistant is defective, the rotor is braked to strong
45	Over temperature frequency converter	Motor runs hard, ventilation is defective, frequency converter is not cooled enough
46	Over temperature motor	Motor runs hard, ventilation is defective
47	Over current frequency converter	Frequency converter is defective, motor is defective
48	Timeout between control unit and frequency converter	Software of the unit has a black out
49	Other error frequency converter	Summary of very specific error, which should normally not occur. (No release, internal timing error, system error, reset by watch dog, start a trial with direction of rotation error, program memory CRC error)
55	Overspeed	Transmission error, firmware error, frequency converter us defective
70	Timeout at control unit through the RS232 interface	RS232 connection is interrupted.
99	Rotor is not allowed in this centrifuge	The number of the inserted rotor does not exist in the data record of the firmware.
rotor no	No rotor detected	It was no rotor installed. Transponder in the rotor is defective or missing, antenna defective, cable break, plug is loosen, control board defective. In rare cases a transponder-antenna combination can cause a reduce range, that a conversation can't occur.
FALSE	The rotor, which is stored in the program, does not match with the inserted rotor.	There was chosen a program, in which a certain rotor is stored, but the inserted rotor is another one.

9. Maintenance

9.1 Maintenance and cleaning

9.1.1 General

Care:

Maintenance of the centrifuge is confined to keeping the rotor, the rotor chamber and the rotor accessories clean as well as to regularly lubricating the rotor insert bolts of a swing out rotor (if available).

The most suitable lubricant is the offered HERMLE High EF oil – Order no.: 34-5147.

Lubricants containing molycote and graphite are not allowed.

Please pay special attention to anodized aluminium parts. Breakage of rotors can be caused even by slightest damages.

In case of rotors, buckets or tube racks getting in touch with corrosive substances the concerned spots have to be cleaned carefully.

Corrosive substances are for instance: alkalis, alkaline soap solutions, alkaline amines, concentrated acids, solutions containing heavy metals, water-free chlorinated solvents, saline solutions, e.g. salt water, phenol, halogenated hydrocarbons.

Cleaning – units, rotors, accessories:

- Turn the device off and disconnect it from the power supply before you begin any cleaning or disinfecting. Do not pour liquids into the housing interior.
- Do spray disinfectant on the device.
- Thorough cleaning not only has its purpose in hygiene but also in avoiding corrosion based on pollution.
- In order to avoid damaging anodized parts such as rotors, reduction plates etc., only pH-neutral Detergents with a pH-value of 6-8 may be used for cleaning. Alkaline cleaning agents (pH-value > 8) must not be used.
- After cleaning, please ensure all parts are dried thoroughly, either by hand or in a hot-air cabinet (max. Temperature + 50°C).
- It is necessary to coat anodized aluminium parts with anti-corrosion oil regularly in order to increase their life-spans and reduce corrosion predisposition.
- Due to humidity or not hermetically sealed samples, condensate may be formed. The condensate has to be removed from the rotor chamber with a soft cloth regularly.

The maintenance procedure has to be repeated every 10 to 15 runs, but at least once a week!

- Connect the unit to the power supply, after the equipment is completely dry.
- Do not carry out disinfection with UV-, beta- and gamma-raysor other high energy radiation.
- Metal rotors can be autoclaved.
- Rotor lid and adapters can also be autoclaved (max. 121°C, 20 min).
- The tube racks are made of PP and can **not** be autoclaved at 134°C.

9.1.2 Cleaning and disinfection of the unit

1. Open the lid before you turn off the unit. Disconnect it from the power supply.
2. Open the rotor nut by turning the rotor key clockwise.
3. Remove the rotor
4. For cleaning and desinfection of the unit and the rotor chamber using the above mentioned cleaner.
5. Clean all accessible areas of the device and its accessories, including the power cord with a damp cloth.
6. Wash the rubber seals and rotor chamber thoroughly with water.
7. Rub the dry rubber seals with glycerol or talc to prevent these to becoming brittle. Other components of the unit, e.g. the lid lock, motor shaft and rotor must not be greased.
8. Dry the motor shaft with a soft, dry and lint-free cloth.
9. Control the unit and accessories for damage.

Remove at least every six months adherent dust from the ventilation slots in the centrifuge by using a brush.

9.1.3 Cleaning and disinfection of the rotor

1. Clean and disinfect the rotors, rotor lids and adapters with the above mentioned cleaner.
2. Use a bottle brush to clean and disinfect the rotor bores.
3. Rotoren, Rotordeckel und Adapter gründlich mit Wasser abspülen. Besonders die Rotorbohrungen von Festwinkelrotoren beachten.
4. For drying of the rotors and accessories set them on a towel. Place the angle rotors with bores down, to dry them to.
5. Dry the rotor cone with a soft, dry and lint-free cloth and look for damage. Do not grease the rotor cone.
6. Place the dry motor onto the motor shaft.
7. Pull the rotor nut tight by using the rotor-key.

9.1.4 Disinfection of aluminium-rotors

In case of infectious material spilling into the centrifuge, the rotor and rotor chamber have to be disinfected right after the run. Rotors may be autoclaved at a maximum temperature of 121°C.

9.1.5 Disinfection of PP-rotors

Autoclaving

The recommended time for autoclaving: 15 – 20 min at 121°C (1 bar)

⚠ **Attention: The sterilization time of 20 min. must not be exceeded. Sterilization again and again will cause reduction of the mechanical resistance of the plastic material**

Before the autoclaving the PP-rotor and adapter must thoroughly be cleaned to avoid the burning in of dirty residues.

You can disregard the consequences of some chemical residues to plastic materials at ambient temperatures. But at the high temperatures of the autoclaving those residues may corrode and destroy the plastic. The objects must be thoroughly washed up with distilled water after the cleaning

but before the autoclaving. Residues of any cleaning liquids may cause fissures, whitening and stains.

Gassterilization

Boxes, bottles and rotors may be gassterilized with Ethylenoxyd. According to the duration of the application you may give long enough an airing to the items after the sterilization and before using them again.

Attention: Because the temperature may rise during the sterilization, rotors, boxes and bottles must not be closed respectively must be totally unscrewed

Chemical sterilization

Bottles, boxes and rotors may be treated with the usual liquid disinfectants.

Attetention: Before applying any other cleaning resp. Decontamination method than recommended by the manufacturer, contact the manufacturer to ensure that it will not damage the unit or the rotor.

9.1.6 Glass breakage

With high g-values, the rate of glass tube breakage increases. Glass splinters have to be removed immediately from rotor, buckets, adapters and the rotor chamber itself. Fine glass splinters will scratch and therefore damage the protective surface coating of a rotor. If glass splinters remain in the rotor chamber, fine metal dust will build up due to air circulation. This very fine, black metal dust will extremely pollute the rotor chamber, the rotor, the buckets and the samples.

If necessary, replace the adapters, tubes and accessories to avoid further damages. Check the rotor bores regulary for residues and damages.

Attention: Please check the relevant specifications of the tubes centrifuges with the manufacturer!

9.1.7 Service life of rotors, round and rectangular buckets, accessories

Rotors and rotor lid made of aluminium or stainless steel, have a operating life of max. 7 years from first use.

Transparent rotor lids and caps made of PC or PP as well as rotors, tube racks and adapters of PP have a maximum service life up to **3 years** from first use.

Tube racks, which are used in rotor no. 221.12 V03 have a service life up to **1 year** from first use.

Condition for the operating life:

Proper use, damage-free condition, recommended care.

10. Flow diagrams

10.1 Flow diagram 230 V / 120 V / 50-60 Hz, page 1

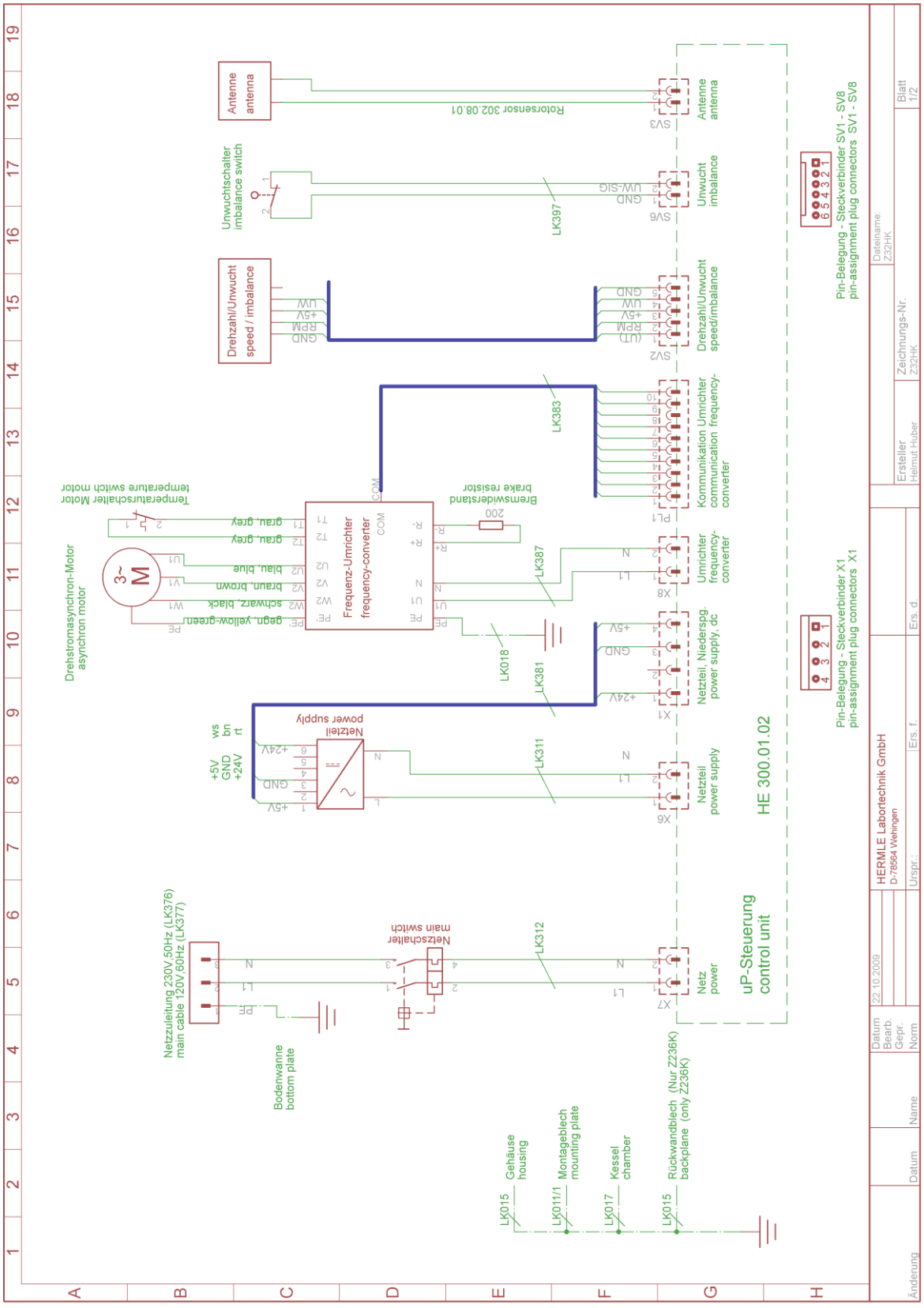

Figure 71: Flow diagram, part 1

10.2 Flow diagram 230 V / 120 V / 50-60 Hz, page 2

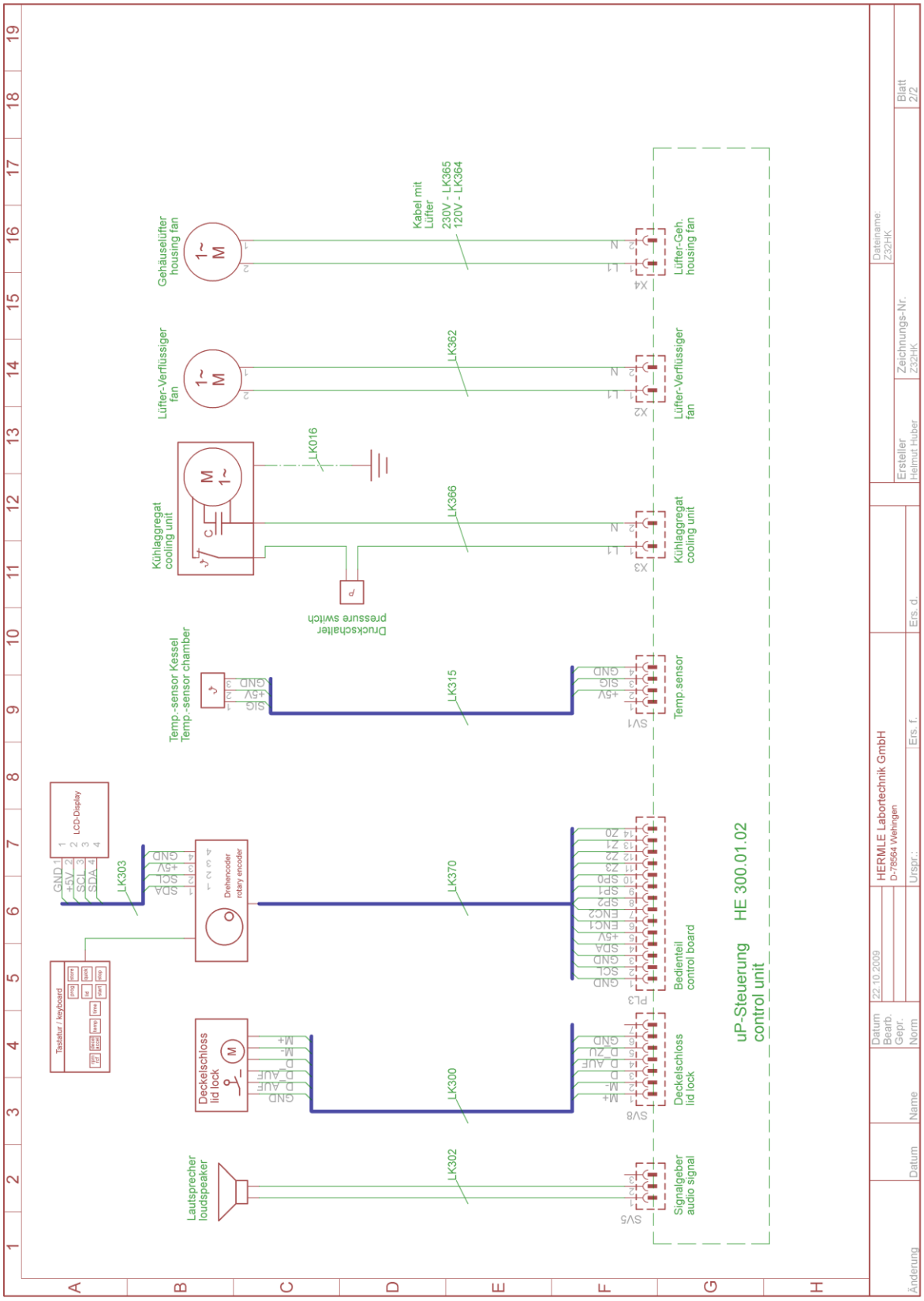

Figure 72: Flow diagram, part 2

10.3 Control board

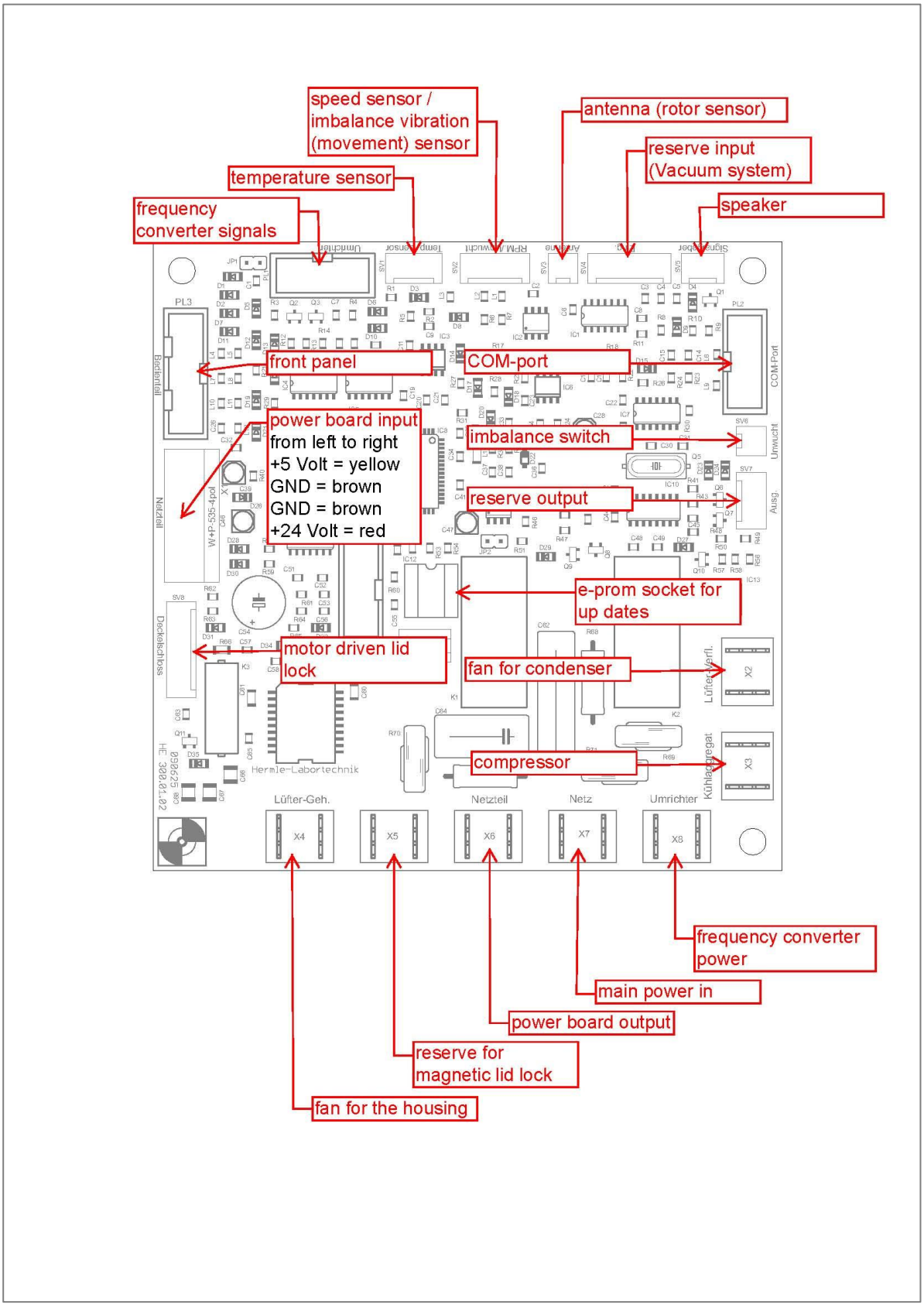

Figure 73: Control board

11. Spare part list

ARTICLE	Order-No.
Controller board	941.002
LCD module	941.005
Rotary knob with PCB for front bonnet	941.006
Membrane keyboard cooled	914.007
Frequency converter 230 V	914.008
Frequency converter 120 V	914.009
Power board 230/120 V	914.015
Power board 230/120 V; retrofit kit	914.018
Upper front bonnet complete	914.021
Motor 230/120 V	924.006
Upper front bonnet (plastic part)	934.002
Sight glass	934.006
Lower front bonnet (main switch inside the ground plate)	934.023
Lower front bonnet (main switch inside front bonnet)	934.024
Back side metal shield	934.025
Insulating ring	934.026
Lid	934.027
Break resistor, 230 V, rectangular	940.242
Signaling transmitter	944.001
Lid lock	944.002
Motor for lid lock 230/120 V	944.003
Micro switch for lid lock	944.004
Rotary knob	944.007
Thermical circuit breaker (main switch) 230 V	944.009
Rotor sensor	944.011
Lid for poti	944.012
Thermical circuit breaker (main switch) 120 V	944.013
Power cord	944.032
Temperature sensor	944.036
Fan 230 V	944.037
Fan 120 V	944.038
Power cord 120 V	944.039
Motor cover	950.172

Sight glass	950.173
Hinge (stainless, silver)	950.174
Rubber foot	954.015
Imbalance switch holder	954.017
Chamber gasket, grey	954.018
Motor rubber mount	954.019
Dryer	960.042
Expansions valve	960.056
Compressor 230 V	964.013
Compressor 120 V	964.014
Condenser 230 V	964.015
Condenser 120 V	964.016

Table 4: Spare part list